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Proposition of Information Processing and Analysis Technology Education in the Era of Hyperconnection, Hyperintelligence, and Hyperconvergence

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Abstract

For the purpose of this study, in order to adapt to the era of intelligent informatization in the 4th Industrial Revolution, we propose an information processing and analysis technology education plan that can solve problems through information search and collection. To this end, first, we explored the necessity and content of information processing and analysis technology in hyperconnection, hyperintelligence, and hyperconvergence under the theme of various majors in IT, focusing on understanding information technology in the software and hardware curriculum. Second, the curriculum improvement plan was proposed based on information literacy, computing thinking skills, and cooperative problem-solving skills for efficient software and hardware-linked curriculum operation based on information processing and analysis technology. Third, I would like to emphasize that it is essential to secure connectivity between other studies for future innovation in new technologies related to computer technology, machine technology, and infrastructure technology through hyperconnection, hyperintelligence, and hyperconvergence in the software and hardware curriculum. Through this, we intend to cultivate creative convergence talent required by the future society.

Keywords: *Bigdata, Information Analysis, Information Processing, Hyperconnection, Hyperconvergence, Hyperintelligence*

1. INTRODUCTION

The 4th Industrial Revolution meant a great change in the system, such as production and management of the entire industry, and became a source of change in the paradigm of the overall manufacturing industry. Since the 4th Industrial Revolution can change the fundamental constitution and economic paradigm of the existing industrial ecosystem, rather than just a productivity revolution, the public sector's response and preemptive support are more urgent than the previous industrial revolution. The characteristics of the 4th Industrial Revolution can be said to be hyperconnection, hyperintelligence, and hyperconvergence. Hyperconnection refers to a hyperconnected society in which all individuals can communicate organically through the Internet of Things (IoT) and the Internet of Everything (IoE). Hyperintelligence refers to a society in which technology and industrial structure are hyperintelligent by analyzing large-scale data to identify certain patterns, and linking and converging artificial intelligence and Bigdata. Predictability of predicting human behavior based on analysis results through hyperintelligence is emerging.

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Hyperconvergence refers to the convergence of ultra-large amounts of data generated through computers and the Internet in the 3rd industrial revolution era into various high-tech technologies such as artificial intelligence, Internet of Things, robots, drones, and autonomous vehicles. And the characteristic of the 4th industry is to create new values through this process. In the 4th Industrial Revolution, Bigdata refers to all data generated in a digital environment, and is an information asset that has the characteristics of high-volume, high-velocity, high-variability, and high-variability, and needs to secure high-verity. Bigdata technology consists of data processing technology that collects and stores data and data analysis technology that analyzes and visualizes data [1]. Bigdata technology enables more information utilization and linkage by processing vast amounts of data at low cost and at high speed. Data that leads to collection, processing, transaction, and utilization in all industries is a core technology of ICT. New businesses using data in various fields such as finance, medical care, and content are continuously created, accelerating the digital economy, and spreading to a new economic paradigm. The ripple effect of Bigdata technology is expected to increase further thanks to the rapid development of the digital-based convergence industry amid changes in the environment of the 4th industrial revolution. As hyperconnection and hyperintelligence accelerate, convergence between the technologies presented above is rapidly developing. In addition, as advanced material and component technologies are fused into this field, the boundaries between the physical and cyber worlds disappear, and online virtual spaces that are organically connected and communicated are being presented. At a time when existing industries need to be advanced based on ICT convergence and at the same time create new industries that have not existed before, cultivating technologies related to information processing and analysis is considered an important competency in driving national development.

2. CURRICULUM CONTENTS RELATED TO INFORMATION PROCESSING AND ANALYSIS TECHNOLOGY IN HYPERCONNECTION, HYPERINTELLIGENCE, AND HYPERCONVERGENCE

By converging hyperintelligence based on Bigdata and artificial intelligence with hyperconnection that originated from IoT, it is at a critical point in time when information processing, analysis, and discrimination-related ability is required at a time when people, objects, and data are intelligently interconnected one-to-one, one-to-many, and many-to-many.

2.1 The Need for Information Processing and Analysis Technology in Hyperconnection

Hyperconnection refers to an Internet of Everything infrastructure in which people and objects (space, living, information, business, etc.) are organically connected to each other in a network without boundaries between physical and virtual. In a hyperconnected society, organic communication between all individuals is possible, and the development of ICT technology is connected to a network that can provide intelligent and innovative services in various industries such as manufacturing, distribution, medical care, and education. The change that a hyperconnected society will bring about is not just the development of the existing Internet and mobile, but a big change from a social point of view. In particular, the hyperconnected society is implemented based on the Internet of Things (IoT) and has been expanded to virtual reality (VR) and augmented reality (AR) to provide services. In order to realize such a hyperconnected society, the ability related to information processing and analysis technology is essential to detect the status and changes of people, objects, and data in real time and convey mutual meaning.

2.2 The Need for Information Processing and Analysis Technology in Hyperintelligence

Hyperintelligence refers to the hyperintelligence of technology and industrial structure through the connection and convergence of artificial intelligence and Bigdata. Hyperintelligence technology advances are accelerating as computing power increases exponentially, enabling Bigdata collection and analysis and strengthening information processing and analysis technologies. Artificial intelligence has been introduced in all industrial fields, and artificial intelligence that surpasses human intelligence has begun to emerge in certain fields. A hyperintelligent society refers to a hyperintelligent information society in which objects can learn and evolve on their own, think about a problem like a person, learn, reason, adapt, and demonstrate it, and solve a specific problem on their own. In addition, in a hyperintelligent society, it does not only utilize the information contained in the system, but also means more rational decision-making through information sharing with various surrounding systems. In particular, a hyperintelligent society can derive optimal synergy effects by efficiently converging various technologies such as IoT, computing, artificial intelligence, and Bigdata analysis.

2.3 The Need for Information Processing and Analysis Technology in Hyperconvergence

Hyperconvergence refers to the ecosystem of convergence of various previously separated areas as hyperconvergence and expansion of hyperintelligence. It means that networks, platforms, terminals, and contents aim for convergence and integration within the ecosystem, and that new technologies, services, industries, and media are created by transforming existing industries into more efficient and productive industries through the convergence of IT and existing industries. The recent evolution of ICT hyperconvergence technology is a technology that replaces human intellectual and flexible situational adaptation in the manufacturing and service industries, expanding human-specific intelligence and growing into new ICT and convergence technologies. In particular, hyperconvergence refers to an integrated system of software and network technologies that can make decisions by strengthening the ability to perceive, learn, and reason about the real world. In other words, data communication networks combined with computing power are mechanizing major parts of human knowledge labor such as discovery, accumulation, utilization, and creation of knowledge beyond simple information processing and information exchange.

2.4 Subjects related to Information Processing and Analysis Technology in Hyperconnection, Hyperintelligence, and Hyperconvergence

The information analysis and discrimination required in hyperconnection, hyperintelligence, and hyperconvergence are presented in Table 1 [2, 3].

3. EDUCATION PLAN RELATED TO INFORMATION PROCESSING AND ANALYSIS TECHNOLOGY

3.1 Educational Competence

Human resources in the knowledge and information society in the 21st century should not only properly utilize information and information processing technology, but also have the ability to creatively create new knowledge, information, and technology and solve problems cooperatively. Informatics is an academic field for creatively and efficiently solving problems in real life and various academic fields based on the basic concepts, principles, and technologies of computer science. Education competencies related to information processing and analysis technologies are presented in Table 2. However, abstraction presented in sub-elements is a technique used to eliminate the complexity of the problem and consists of methods such as

extraction of key elements, problem decomposition, modeling, classification, and generalization. Problem-solving models derived through the abstraction process are automated through programming [4].

Table 1. Curriculum contents related to information processing and analysis technologies necessary for hyperconnection, hyperintelligence, and hyperconvergence

Type	Concept	Subject contents
Hyperconnection	People, things, etc between objects organic connection	Computer Programming, Computer Architecture, Operating Systems, Introduction to Digital Signal Processing, Networks, Digital Communications, Data Communications, Multimedia Communications, Mobile Telecommunication Engineering, Information System Security, Cryptography, Authentication System
Hyperintelligence	Optimal decision making on the basis of data sharing	Probability, Statistics, Statistical Data Analytics, Data Mining, Design and Development of Information Systems, Bigdata Distributed Computing, Machine Learning, Artificial Intelligence, Intelligent System, Control Engineering, Robot Engineering, Human Computer Interface, Pattern Recognition, Computer Vision, Embedded Processors
hyperconvergence	Heterogeneous technologies and the emergence of new technologies and industries through the combination of industries	Data Integration and Analysis, Management Information System), Digital Image Processing, Multimedia Processing & Application, Computer Graphics, Game Programming, Augmented Reality, Digital Content and Platform

Table 2. Education competencies related to information processing and analysis technologies

Curriculum competence	Meaning	Subelements
Information culture literacy	Ability to understand the value of the information society and use information technology to solve problems	Information protection capability Ability to utilize information technology
computing thinking ability	Ability to use the basic concepts and principles of computer science and computing systems to understand problems in real life and various academic fields and to creatively implement and apply solutions	Abstraction capability Automation capabilities creativity and convergence capabilities
cooperative problem-solving skills	Ability to creatively solve problems through efficient communication and collaboration in a diverse knowledge and learning community based on a network computing environment	Collaborative computing thinking skills Digital communication skills Ability to share and collaborate

3.2 Training Objectives

Information is a subject that fosters the ability and attitude to create new knowledge and skills and apply them integrally to solve real-life problems along with the exploration of computer scientific knowledge and technology [5]. Education goals related to information processing and analysis technologies are presented in Table 3.

Table 3. Education goals related to information processing and analysis technologies

Type	Remark
General Objectives	- Developing awareness of information ethics, information protection capabilities, and information technology utilization capabilities - Focusing on basic concepts and principles of data processing and analysis, and computing skills, developing the ability and cooperative attitude to solve real-life and diverse academic problems in a creative and efficient manner
Detailed Objectives	- Understanding the characteristics of the information society and cultivating an attitude to properly practice information ethics and information protection - Developing the ability and attitude to efficiently manage and produce information using information technology - Cultivating the ability to design solutions by abstracting problems based on computing principles - Cultivating the ability to automate software implementation through the programming process - Cultivating the ability to understand the configuration and behavior of computing systems and implement creative computing systems

3.3 Curriculum Development Plan and Recommendations

In order to cultivate creative and convergent talents through information education, it is essential to secure the identity of the information subject, the hierarchy between instructors and learners, and the connection between other studies. By properly selecting and applying information courses to help learners adapt to the new science and technology environment, learners want to learn key elements of information through creative class activities to lay the foundation for innovative future technologies such as computing, machine, and infrastructure education [6, 7] The information processing and analysis technology curriculum improvement plan related to this is presented in Table 4.

4. EMPIRICAL STUDY ON INFORMATION PROCESSING AND ANALYSIS TECHNOLOGY EDUCATION

4.1 Research Methods and Results

In this section, first, software majors in computer science and hardware majors in computer engineering want to analyze data and information management, artificial intelligence, software, and hardware engineering by grade in information processing and analysis technology-related subjects. Second, I would like to analyze the major recognition of how hyperconnection, hyperintelligence, and hyperconvergence are applied and utilized in the field of software and hardware. Third, the purpose is to analyze IT technology and engineering skills, information processing, and information exchange-related majors by track major of 4th-grade software and hardware, respectively. For this study, 40 students from each grade were selected to participate voluntarily in the study by selecting Department C of Software and Department E of Hardware

Engineering at S University in Seoul, and a survey was conducted from June 15 to 29, 2020 according to the school's academic schedule.

Table 4. Goal of curriculum improvement plan related to information processing and analysis technology

Type	Factor	Content elements	Achievement standards
Instructor	Teaching method	Creative teaching activities	Explanatory teaching, exploratory learning, project learning, discussion and discussion learning, cooperative learning, learning using media and tools
⇩	⇩	⇩	⇩
Key Learning Areas	Key Learning Areas	Data and information management	Exploratory data analysis, Bigdata education (data mining and machine learning-based data analysis)
		Artificial intelligence	Intelligent systems, machine learning
		Software engineering	Algorithmic design, network, operating system, human-computer interaction (HCI), information protection and Security
		Hardware engineering	Computing systems, intelligent robots, drones, IoT, autonomous vehicles
⇩	⇩	⇩	⇩
New future technology innovation	Hyperconnection Hyperintelligence Hyperconvergence	computing technology	Deep learning, understanding Bigdata processes and new technologies, emotional computing, question-and-answer systems, automatic interpretation
		Machine technology	Wearable device, personal assistant robot, learning adaptive robot, logistics automation robot, unmanned courier machine
		Infrastructure technology	Cloud computing, Internet of Things, 5th generation mobile communications

Table 5. Analysis of results on recognition related to hyperconnection, hyperintelligence, and hyperconvergence by grade (units: frequency (%))

Factor	Year	N	Software	Hardware
Hyperconnection	1	40	13 (32.5%)	12 (30.0%)
	2	40	19 (47.5%)	21 (52.5%)
	3	40	22 (55.0%)	22 (55.0%)
	4	40	25 (62.5%)	24 (60.0%)
Hyperintelligence	1	40	17 (42.5%)	15 (37.5%)
	2	40	23 (57.5%)	22 (55.0%)
	3	40	33 (82.5%)	26 (65.0%)
	4	40	35 (87.5%)	33 (82.5%)
Hyperconvergence	1	40	12 (30.0%)	13 (32.5%)
	2	40	17 (42.5%)	19 (47.5%)
	3	40	21 (52.5%)	23 (57.5%)
	4	40	24 (60.0%)	26 (65.0%)

Table 6. Analysis of results on recognition related to hyperconnection, hyperintelligence, and hyper-convergence by track (units: frequency (%))

Factor	Type	Track	N	Result
Hyperconnection	Software	System integration	40	11 (27.5%)
		Software development	40	10 (25.0%)
		Embedded system software	40	13 (32.5%)
		Multimedia and game software	40	27 (67.5%)
	Hardware	Business information technology	40	16 (40.0%)
		Microwave and light wave	40	10 (25.0%)
		Semiconductor and electronic material	40	11 (27.5%)
		System and control	40	10 (25.0%)
		Information communication and signal process	40	31 (77.5%)
		Computer and circuit design	40	12 (30.0%)
Hyperintelligence	Software	System integration	40	10 (25.0%)
		Software development	40	12 (30.0%)
		Embedded system software	40	9 (22.5%)
		Multimedia and game software	40	30 (75.0%)
		Business information technology	40	17 (42.5%)
	Hardware	Microwave and light wave	40	9 (22.5%)
		Semiconductor and electronic material	40	10 (25.0%)
		System and control	40	14 (35.0%)
		Information communication and signal process	40	32 (80.0%)
		Computer and circuit design	40	10 (25.0%)
Hyperconvergence	Software	System integration	40	9 (22.5%)
		Software development	40	10 (25.0%)
		Embedded system software	40	9 (22.5%)
		Multimedia and game software	40	30 (75.0%)
		Business information technology	40	13 (32.5%)
	Hardware	Microwave and light wave	40	10 (25.0%)
		Semiconductor and electronic material	40	9 (22.5%)
		System and control	40	19 (47.5%)
		Information communication and signal process	40	30 (75.0%)
		Computer and circuit design	40	11 (27.5%)

4.2 Measures to Improve Education

Comprehensively analyzing the above survey results, it is judged that it is not possible to cultivate human resources with information processing and analysis-related skills that can play a leading role in the 4th industrial information age through the current software and hardware education policy. It is believed that IT education methods for information processing and analysis technology-related courses need to be improved in order to cultivate manpower suitable for the 4th Industrial Revolution, which has the ability to fuse new technologies in various fields such as artificial intelligence, Bigdata, Internet of Things, and robotics. To this end, first, in order to strengthen knowledge information processing capabilities in the IT curriculum, it is necessary to provide learner-centered, customized education by developing subjects that can be characterized by linking detailed tracks of software and hardware majors. Second, the software and hardware departments

intend to strengthen the foundation for integrated software and hardware education by opening new common courses. Third, through strengthening basic major literacy education, various types of hyperconnected, hyperintelligent, and hyperconvergence education are required to combine with software and hardware major knowledge and provide practical learning experiences. 4th, by developing practical examples suitable for the era of hyperconnection, hyperintelligence, and hyperconvergence, we intend to cultivate creative convergence talents required by the future society through the development of textbooks.

5. CONCLUSION

The current software and hardware sectors face new challenges due to the spread of various new technologies leading the 4th Industrial Revolution, the introduction of new systems, and the creation of new values through convergence with other fields. In order to survive in the global market, not only the ability to create and promote new ideas, but also the ability to open the stage for new technologies through hyperconnection, hyperintelligence, and hyperconvergence with software, hardware, and other fields. This study attempted to derive improvements and revise and supplement the curriculum by reviewing the nature, goals, content systems, and appropriateness and suitability of the curriculum related to information processing and analysis technology. To improve teaching-learning of major subjects related to information processing and analysis technology in the software and hardware curriculum, this study analyzed the contents of hyperconnection, hyperintelligence, and hyperconvergence in software and hardware. By teaching and learning the innovative technologies of the 4th Industrial Revolution, data and information management, information processing and information exchange, and artificial intelligence, in the software and hardware curriculum, we presented a plan to improve the ability as an information processing analysis expert to contributing to the creation of new technologies in the era of hyperconnection, hyperintelligence, and convergence.

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